Immersion or injection?

– practical considerations of vaccination strategies

Vaccines are marketed in Greece to protect against serious bacterial systemic diseases of farmed seabass (*Dicentrarchus labrax*) and seabream (*Sparus auratus*).

They comprise formalin-killed bacterins or oil-adjuvanted products. Products that may be administered orally by mixing with the fish feed are also appearing on the market.

The available vaccines may offer protection against several pathogenic serotypes of *Vibrio anguillarum* causing vibriosis to seabass, and/or the *Photobacterium damsela* subspecies *piscicida* (*Pasteurella piscicida*) causing pasteurellosis (or pseudotuberculosis) to both bass and bream.

The different products that are marketed at present are either monovalent – offering protection against one bacterial strain – or multivalent – protecting against more than one.

The application methods and the vaccination schemes that are suggested by the vaccine distributors differ, but all employ either the immersion of the fish in groups in a suitable vaccinal dilution and/or the intraperitoneal injection of individual fish with a specific dose of undiluted vaccine.

Oral vaccination is by far less common, as oral vaccines have yet to realise consistently good results.

The practical needs in terms of implements, workforce and time, differ according to fish size, the type of holding unit (net pen, tank, raceway) and the application method employed. Injection vaccination on the cages at sea is considerably more time-consuming and labour-intensive, as the fish have to be anaesthetised and treated individually.

On the other hand, immersion vaccination proceeds fast as groups of fish are added simultaneously to a vaccine dilution. Therefore, the vaccination schemes depend not only on the epizootiology of the site and the duration of the production cycle compared to the expected period of immunity cover, but also on the availability of time and labour on each particular unit.

Immersion

In immersion – or 'dip' – vaccination, large groups of fish are cut off from the rest in a cage and enclosed in a tarpaulin where a slight dose of diluted anaesthetic is added to sedate them. Air or oxygen is continuously pumped in to avoid anoxia.

The proper vaccine quantity is calculated according to the estimated biomass of the fish to be vaccinated (usually for every 100kg of fish one litre of vaccine is required). The vaccine is diluted with seawater in a suitable receptacle (the common dilution rate is 1:10 – ie, nine litres of water for each litre of vaccine). Oxygen may be trickled through the vaccine dilution to reduce stress.

The sedated fish are netted out of the tarpaulin in lots of approximately 0.5kg, avoiding overcrowding or crushing. Holding water is drained from the fish, which are then placed in the vaccine dilution where they are allowed to swim for a certain minimum time, usually at least 30 seconds.

Common practice is to place the netted fish from the tarpaulin in a perforated plastic bowl within the dilution container. When immersion time is up, the fish are withdrawn from the vaccine dilution and released in their holding facility.

Injection

When seabass are sufficiently large (more than 50g average weight) the vaccine may be safely administered undiluted by injecting them intraperitoneally using injection guns.

As with immersion, groups of fish are cut off from the rest in a cage released according to size class into distinct channels. Water is pumped from the sea into the channels and flushes the fish along tubes leading them to different cages.

The table, pumps, tubing and all other implements are often installed on a floating platform.

Costing

Appreciating the cost of immersion vaccination is relatively easy, as all necessary implements are cheap and are either used for other tasks – and hence are readily available – or can be quickly made 'in-house' (for example, ordinary household plastic bowls can be purchased from super markets and perforated with an electric drill on-site).

The major cost items comprise consumables, such as vaccines, anaesthetics, fuel, oxygen, etc. Labour costs may not be included in the calculation when the vaccinators are drawn from the regular farm workforce.

Fish losses due to handling stress or mishaps are often negligible when immersion vaccination is performed methodically (also, the fish are still rela-

General principles

- Vaccination is recommended only for healthy fish which are not under any stress. It is not indicated when fish are suffering a disease outbreak or have been through recent severe handling or other and enclosed in a tarpaulin, but because the fish are larger, a smaller number of them is enclosed. Extra care is also required when supplying the anaesthetic, as the larger the fish the greater the risk of self-injury due to stress reactions.

Subsequent to sedation in the tarpaulin, small groups of fish are netted out and placed in a container with a higher dose of anaesthetic dilution until completely immobile.

The anaesthetised fish are then taken to a vaccination table where they are handled individually. The vaccination table consists of one or more troughs filled with water where the immobile fish are presented to the operators floating belly-up.

A vaccine dose (usually 0.1 to 0.2ml) is injected in the abdominal area of each fish held with the ventral side up and the head away from the operator's body. The needle is inserted into the peritoneal cavity at a 45deg angle to a depth of approximately 0.5cm. Automatic injection guns are used for this purpose.

Subsequent to injection, the fish are released into their holding unit where they recover from anaesthesia in a few minutes.

Usually, the vaccination table is constructed in a way that allows simultaneous easy grading of the injected fish into size groups. The fish are

■ Fish should stay off food prior to vaccination in order to have an almost empty gastrointestinal tract at vaccination. The smaller the fish and the higher the water temperature, the smaller the required fasting interval. Fasted fish suffer less handling stress and respond better to anaesthetics.

■ Vaccination must be performed in a disease-free environment and precede exposure to disease or transfer to a disease-prone site by about two weeks when water temperatures range around 15degC (at least 200 degree-days). Smaller intervals are required for the establishment of immunity at higher water temperatures.

■ At dip vaccination, the temperature difference between vaccinal dilution and holding water should not exceed 2degC.

tively small and of low value).

Apart from the consumable items, which are the same as those for immersion, injection vaccination requires considerable investment in infrastructure.

A spacious, steady working platform (raft) is paramount. The vaccination table has to be ergonomically designed and made according to its expected use – ie, not only for injecting fish but also for grading and counting.

A powerful enough water pump is important to supply plenty of running water to the grading channels. Injection guns do not comprise a major cost element, but need to be meticulously maintained after use. Four to five guns plus at least one spare have to be available.

Serious efforts are being made by large fish farming groups towards the adjustment for use with bass of automatic injection machines used for salmon vaccination in Northern Europe. However, one must note that seabass is a far more delicate fish to handle than salmon.

Injection vaccination of seabass is a labour-intensive operation, and often casual labour is employed. Hence, labour becomes a serious cost element when budgeting vaccination costs.

In addition, fish losses due to handling stress and trauma

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Vaccinating fish at on-growing cage sites is an important part of the production process. Here, **Dr PANOS VARVARIGOS**, director of Vet Care Ltd, a Greek distributor of vaccines from Aqua Health Ltd, explains the practical considerations when planning to vaccinate seabass or seabream at on-growing sites

should be accounted for. Not only can they reach 1% of injected fish or more, but the fish are larger and hence of greater value.

Strategies

The vaccination strategies for seabass and seabream depend on a combination of the following:

- Epizootiology of the particular site and area;
- Sensitivity of the fish species and age group to particular pathogens;
- Expected time span of immunity;
- Expected duration of the production cycle; and
- Labour and infrastructure available

There is an obvious correlation between the lasting result of vaccination and the size/age of fish at vaccination (development of anosopoietic tissues).

Seabass frequently suffers vibriosis outbreaks at any stage during their grow-out period. On the other hand, pasteurellosis may become a problem for bass mainly during the first summer, or until the fish reach about 70g.

Immunity lasts longer the older/heavier the fish are. Immersion vaccination of small bass – 1.5 to 2g average weight – against vibriosis should provide effective cover for about six months, whereas when the

pable of effectively utilising the vaccine antigens.

This casts doubts over whether vaccination would be beneficial and whether it constitutes a sound recommendation for on-growers.

Seabream is far more resistant to environmental stress and suffers from bacterial diseases mainly when young. As it grows, its resistance to bacterial infections strengthens, and it is thus perceived as a 'safe' fish to grow.

Seabream suffers greatly from acute pasteurellosis when very young (0.1g to 1g). Pasteurellosis outbreaks usually decimate hatchery stocks. Therefore, measures to protect it from the disease have to be taken early in the hatcheries.

Unfortunately, efforts to immuno-stimulate and vaccinate bream at such an early stage of its life have been unsuccessful. Later, when the fish reach 4g, they become capable of resisting acute infections.

As they grow on, pasteurellosis outbreaks, although not uncommon, are of the chronic form with a limited death toll. Antibiotic treatments are effective against such relatively mild outbreaks.

Therefore, the merits of bream vaccination at the on-growing sites are still debatable. A sound proposal would

ing, that some Greek farmers who have adopted vaccination strategies have done so following repeated, devastating disease occurrences.

Nevertheless, it is certain that there will be no profitable future for the intensive marine farming of bass and bream in Greece unless vaccinations are widely adopted, and the administration methodologies and technologies continuously upgraded in accordance with the evolving farming environment.

Comparing the costs

Cost elements	Immersion	Injection
Consumables	Vaccines Anaesthetic Oxygen (if from cyliner) Fuel (for air pump) Ancillary items (tubes, bowls, handling nets, ropes, weights, air stones, valves)	Vaccines Anaesthetic Oxygen (if from cyliner) Fuel for air and water pumps Hypodermic needles Ancillary items (as for immersion)
Labour	3 to 4 workers per cage	6 to 8 workers per cage
Time	@100kg/30 mins	@3000 fish/60 mins
Man-hours per 100,000 fish	@20 (5hrs x 4 workers – fish at 10g)	230 (3000 fish/hr x 7 workers – fish at least 50g)
Depreciation	Tarpaulin Air pump (if not O2 cylinders) Oxygen/sea temperature meter	Tarpaulin Vaccination table Air pump (if not O2 cylinders) Oxygen/sea temperature meter Water pump Injection guns Automatic counters (if any) Floating platform
Expected losses due to handling stress, injury or operator error	Negligible (0.05% – small fish of low value)	0.2% to 1% (large fish of considerable value)

fish are larger at vaccination – 10 to 20g – immunity should last for a whole year.

Therefore, when the production cycles are short (when bass is grown to market size in 16 to 18 months), then two vaccinations by immersion would suffice to protect against vibriosis – ie, fry are immersion vaccinated at 1.5 to 2g and a repeat vaccination, also by immersion, is performed when the fish reach about 15 to 20g.

When the production cycle of bass until market size is considerably longer, or in the cases where the fish are to be marketed at much larger sizes than the usual 350g, injection vaccination is necessary and may be combined with counting and grading of the fish by size into distinct groups.

In such cases, the vaccination plan consists of an immersion application when the fish are about 2 to 8g and a second application by injection when the fish obtain an average weight of between 60 and 150g.

Obviously, as injection vaccination is applied to considerably larger fish, immunity is expected to last for a year post-injection. Thus, this plan ensures immunity cover over longer production cycles, even up to 24 months.

Seabream naturally resists vibriosis, but suffers from acute pasteurellosis, frequently suffering very high mortality when still in the hatcheries and until about 4g. Later, during production, bream may also suffer from chronic pasteurellosis with mild losses.

Therefore, to effectively protect bream it would seem sensible to vaccinate fry against pasteurellosis in the hatcheries when very small (0.1 to 1g). Unfortunately, such young bream are inca-

be to vaccinate bream against pasteurellosis by immersion in a monovalent vaccine dilution either prior to delivery to the farm or shortly after when the fish are 1 to 2g.

Constraints

Ideally, fish farmers would like to effectively protect their stocks against the major diseases throughout the production cycle, quickly and with the minimum of cost and effort. Reality, however, is far from this ideal.

Vaccinating fish is not only hard work, but also a delicate operation. Harried manoeuvring of cage nets, fish overcrowding, careless application of anaesthetics, insufficient air or oxygen supply in the tarpaulin, rough handling at injection or when netting and draining from water are some of the many causes of stress and injury which may kill fish.

Time and labour are always scarce on any farm. Therefore, careful job planning is important, especially on large farms. Very often there are conflicts with other crucial operations, such as harvesting or net changing, which divert the necessary labour. Weather conditions may also be unfavourable. Hence, very often, decisions to vaccinate remain wishful thinking.

Money is yet another scarce resource no matter how large or profitable the farm. Vaccination is like insurance: it requires paying for vaccines and equipment and working hard in advance with a view to protecting the fish from future disease outbreaks which are likely to occur but not absolutely certain.

It is tempting to redirect funds to other investments in the hope that the coming production year will be fortuitous.

Therefore, it is not surpris-